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POLYSHOK EVALUATION REPORT
ATF Project No. 03-042

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EVALUATION REPORT

Title: POLYSHOK Ammunition Evaluation, ATF Proj No. 03-042

Sponsor: SOCOM

Test Organization: Armament Technology Facility (ATF), Picatinny Arsenal NJ

Dates: 1-4 Apr 03

References: A. POLYSHOK Operations Manual (copy enclosed)
B. POLYSHOK Tactical Demo Video

PURPOSE

The purpose of this evaluation was to gather quantitative and qualitative data regarding the performance of the POLYSHOK ammunition. This report of findings will provide SOCOM with a basis for assessing the applicability of this type of ammunition to military special operations.

OBJECTIVE

The objective of this evaluation was to validate the scenarios presented during the Tactical Demo Video and to confirm technical specifications provided by the manufacturer.

OUTLINE

The Tactical Demo Video documented the effects of the POLYSHOK ammunition when engaging the following targets at a distance of 30 feet:

a. Firewall.

b. A one gallon water jug.

c. 16 Gauge steel plate.

d. Sheetrock interior wall.

e. Automobile windshield.

f. Level II Body Armor.

g. A one gallon water jug with a second water jug at 3 feet shielded by denim cloth.

In applications b-e, a ½ inch plywood panel was placed immediately behind the initial target to demonstrate lethality against a secondary target. For all applications, a safety

glass backstop was located 10 feet behind the initial target in order to demonstrate the potential for collateral damage.

The evaluation conducted at the ATF on 1-4 Apr 03 was designed re-enact the tactical scenarios performed in the manufacturer's video. The following highlights some key modifications to the evaluation plan:

a. A backstop constructed of plywood, polystyrene insulating foam covered by target paper was substituted in place of the safety glass in order to provide a more subjective indication of the type and lethality of projectiles traveling beyond the intended target.

b. Where possible, some applications were duplicated, substituting a one gallon water jug for the ½ inch plywood panel in order to confirm potential lethality on a secondary target.

c. Ammunition was tested against 20, 16 and 13 Gauge steel plates rather than just against 16 Gauge as per the video.

d. A military issue, hard ballistic insert (7.62 mm M-80 ball protection) and military fragmentation jacket (Interceptor OTV with Kevlar soft ballistic inserts) were used to demonstrate the effect of the ammunition against body armor. In addition, the body armor was placed against ballistic clay to measure the trauma that would be transferred to a human body protected by the armor. For this clay, the depth of penetration considered to be lethal is 1.73 inch.

e. Ammunition was also used against a solid wood core, exterior metal and automobile doors. The ammunition was also evaluated for its effectiveness when used for door breaching (lock and hinge).

High speed and real time video as well as digital photography were used to document the findings of this evaluation. Highlights of the data collected are included in the following report and additional footage is also available if required.

The shotgun used for this entire evaluation was a Mossberg 500 with an 18 ½ inch cylinder bore barrel. This was a new weapon that had only been fired previously by the manufacturer to test for functionality.

Representatives from POLYSHOK, Mr. Jim Middleton (Vice-President) and Mr. Charles Glover, were present from 1-3 Apr 03 to observe the evaluation and provide technical feedback as requested.

TECHNICAL DATA

The POLYSHOK Operations Manual provides technical data regarding this ammunition and the function and performance as recorded by the manufacturer. As described in this manual, the POLYSHOK ammunition is composed of three main components: the

projectile body containing an actuator and a core of spherical lead particles. Weights were measured for five samples and averaged, producing the following data:

a. Entire shell. 44.570 g.

b. Projectile body. 3.633 g.

c. Actuator. 1.136 g.

d. Lead particles. 29.807 g.

Velocity. The velocity of the projectile was measured as it exited the muzzle of the shotgun barrel. Calculations were made using data gathered by the high-speed video of three projectiles. From this data the average velocity was calculated as 1023 feet per second compared with 1045 feet per second that was advertised by the manufacturer (fired from 18 inch barrel, and measured 10 feet from the muzzle). Specific data and calculations are included in the table at Annex A.

Accuracy. For this accuracy evaluation, the shotgun was secured in a stationary mount and the target was placed at 50 yards. During the accuracy evaluation conducted at the ATF, one grouping of five rounds was used to confirm the point of aim, then a second five round burst was used to measure dispersion. The barrel of the weapon was cleaned and a further two applications of five rounds each were used to measure dispersion. From these three applications, the maximum dispersion was measured as 7.500 inch. This result deviated significantly from the accuracy specified (4 inch diameter at 50 yards) by the manufacturer in the Operations Manual. Annex B contains a statement made by the Vice-President of POLYSHOK that addresses this discrepancy, highlighting a manufacturing inconsistency. Specific data and calculations are included at the table at Annex C.

TACTICAL SCENARIOS

Firewall. As per the Tactical Demo Video, two panels of 5/8 inch sheetrock were secured on each side of a standard 2 x 4 inch stud (actual dimensions of 1 ½ x 3 ½ inches). POLYSHOK penetrated all four panels but caused minimal damage to backstop. Three rounds were fired and the most significant damage caused on the backstop was due to the projectile body, actuator and some shrapnel from the sheetrock. Projectiles had a clean entry into the sheetrock and created a 2 inch diameter hole as they exited the far side.

Steel Plate. POLYSHOK ammunition was tested against 0.034 inch (20 gauge), 0.066 inch (16 gauge) and 0.086 inch (13 gauge) steel plate. POLYSHOK penetrated both 20 and 16 gauge steel plate and continued to penetrate the ¼ inch plywood target placed on the far side of a standard 2 x 4 inch stud. POLYSHOK failed on the initial attempt to penetrate 13 Gauge metal with the carrier and actuator remaining embedded in the metal. However, even without fully penetrating the steel plate, a significant amount of energy was still transferred to the plywood target. This is evident in the flexing of the plywood

target seen on high-speed video. Following the first attempt, additional clamps were used to secure plywood target, and the subsequent two attempts successfully penetrated the target even though most of energy was absorbed during impact with steel plate. A very small quantity of lead projectiles impacted on the backstop, causing minimal damage. From this application it was concluded that 12 gauge steel plate should be considered at the upper limit of penetration for this ammunition at 13 feet.

Water Jug. A one gallon water jug was used as the primary target and secured to the target stand. On the first shot, the projectiles penetrated through the jug but lead particles did not significantly impact on the backstop at 10 feet. The high speed video data graphically illustrates the energy transferred as the projectiles travel through the fluid contained by the jug. A concentrated water stream is created which travels in both directions along the same plane as the trajectory of the projectiles. There is also a delayed effect where the jug is violently ripped from the target stand. For the next application, a second water jug was placed immediately behind the first and both were secured to the target stand. The projectiles traveled through the first jug, entered into the second but did not have sufficient force to penetrate the back wall. Accordingly, there was no damage recorded on the backstop at 10 feet.

Interior wall. For this application, one panel of ½ inch sheetrock was secured on either side of a standard 2 x 4 inch stud. A ½ inch plywood panel was also placed 2 inches behind the wall to represent a human target at this distance. Penetration of lead projectiles through the initial target indicates that the shot would be lethal to a human standing 2 feet behind the wall. Analysis of the high-speed video indicates that there was minimal deflection of lead projectiles. A significant amount of lead projectiles did impact onto the backstop at 10 feet however the damage caused was minimal.

Automobile Windshield. A standard automobile windshield was mounted at a 45° angle and a plywood panel was placed 2 feet behind the point of impact to represent a driver or passenger in the front seat of a vehicle. The backstop was located 6 feet behind the plywood target to represent a passenger in the rear seat of a vehicle. High-speed video analysis illustrates that there was minimal deflection in the trajectory of the projectiles as they passed through windshield. The projectiles then impacted with sufficient force to penetrate the plywood target at 2 feet. Additional applications were fired at various points on the windshield and the procedure was repeated using a one gallon water jug in place of the plywood target. In this scenario, the projectiles penetrated into the jug but did not exit through the rear. In all applications, there was minimal effect on the backstop.

Wood (Solid Core) Door. A six-panel colonial style pre-hung solid pine door was used for this portion of the evaluation. The effects of the POLYSHOK ammunition varied depending on the point of impact on the door. For all application, a ½ inch plywood panel was used to represent a secondary target behind the door. Panels provided minimal resistance and projectiles penetrated easily through plywood target. The upper cross beam provided more resistance but projectiles were still able to penetrate the door and produce a lethal effect on the plywood target. Only one of the three shots fired at middle

beam penetrated the door with lethal effect. Ammunition proved to be very effective when used in a door breaching capacity. One accurately placed shot at a stand-off distance of 6 inches completely disengaged the locking mechanism. Additionally, the complete hinge assembly was removed with one shot when fired at a stand-off of 6 inches through the door.

Metal Door. The effect of POLYSHOK was consistent regardless of the point of impact when used against a 22 gauge pre-hung metal storm door. Projectiles produced a lethal effect on both ½ inch plywood and a one gallon water jug when placed 2 feet behind point of impact on door. Projectiles penetrated through a simulated interior wall (two, ½ inch panels of sheetrock on either side of a stud). As with the wood door, the POLYSHOK was used effectively to defeat the locking mechanism on the metal door. The ammunition was not as effective when used against the hinge assembly and would likely require a second shot to completely disable each hinge.

Automobile Door. For this portion of the evaluation, a door from a 1986 Dodge Ram Van was used to represent a standard automobile door. A ½ inch plywood target panel was placed 2 feet beyond the far side of the door to represent a driver of the vehicle. The projectiles penetrated the outside of the door but did not completely penetrate through the interior panel. Points where interior door mechanisms were present showed increased resistance to the POLYSHOK ammunition. Multiple shots were fired at various points on the door but in all of these the lethal effect could not be guaranteed beyond the door.

Body Armour. A hard ballistic insert was placed against ballistic clay to measure effect of ammunition. Due to curvature of insert, clay was molded to eliminate the stand-off distance at point of impact. One shot was fired at the center of the insert. The actuator and projectile body was found embedded in the insert but none of the lead projectiles completely exited through the back of the panel. Regardless, the energy transferred during the impact caused a depression in the clay the measured 3.880 inches in diameter and continued to a maximum depth of 1.074 inches. Therefore the injuries sustained by a human would be considered serious but not lethal.

Fragmentation Jacket. A standard military issue Fragmentation Jacket was hung so that the inside of the front of the jacket made direct contact with the ballistic clay. Shots were fired at various points on jacket to measure the potential effect on a human. Projectiles did not penetrate through the soft ballistic inserts but a significant amount of trauma was still transferred to the clay. Depressions were measured as follows:

a. Lower left panel: 3.155 x 1.762 inches.

b. Upper left panel: 3.721 x 1.975 inches.

c. Middle panel: 3.775 x 1.141 inches.

d. Upper right panel: 3.137 x 1.206 inches.

From this data, the shots fired at the lower and upper left panels would be considered lethal. One shot was also fired directly into ballistic clay, creating a cavity that measured a depth of 2.655 inches and 4.175 inches in diameter.

SUMMARY

In applications where plywood target was used to measure secondary lethality, the most serious damage recorded by the backstop was a result of splinters from the plywood. In numerous applications, the plastic carrier body embedded in the foam however the lead projectiles penetrated just beneath the surface or did not penetrate at all.

Plywood provided some indication of lethality, however ballistic clay or a gel blocks would have been incorporated to give much clearer indication of the effectiveness of the test ammunition. Due to cost and availability of resources, this type of evaluation could not be conducted. Regardless, the objective of the evaluation was to validate the data presented by POLYSHOK.

This evaluation was not exhaustive and variables were kept standard throughout as much as possible. The observations from this evaluation validated the tactical demonstration provided by the manufacturer of POLYSHOK in the video provided. However, the accuracy of the ammunition did not meet the manufacturers specification and this deficiency is currently being addressed by POLYSHOK.

Polyshok Testing at Picatinny Arsenal
April 1-3, 2003

The ammunition we supplied for testing by Picatinny Arsenal met all of our production specifications for terminal ballistic performance and performed as we expected it to in all their tests except for accuracy. After we had shipped the ammunition to the Arsenal for testing, we realized that our supplier of spherical lead powder had changed it's production process to reduce their costs without informing us. This substantially changed the characteristics of the lead resulting in a powder which was no longer uniform in size (nominally about ½ the size of #12 shot). This change did **not** effect the terminal ballistic performance of the Polyshok round in any way as evidenced by the test results we observed at Picatinny.

However, the lead used in the ammunition tested ranged in size from almost a lead dust to slightly larger than #12 shot. The result was ammunition that did not have a uniform weight distribution in it's payload from round to round. This will obviously cause inconsistencies in accuracy. Our company guarantees 4 inch center-to-center groups at 50 yards with any clean and well maintained service shot gun fired from a bench rest. Actual accuracy is normally in the 2 ½ - 3 inch range when fired from a bench rest. During testing at Picatinny our groups ranged from 3 ½ to 8 inches due to this inconsistent weight distribution in our lead payload.

We informed the Picatinny staff of the potential effect on accuracy prior to testing but were unfortunately unable to provide any additional ammunition since we only realized the problem a few days before testing was scheduled to commence. We have already made arrangements with our lead supplier to re-institute the screening process, which until our last order, has provided us with very consistent and uniform diameter spherical lead powder during our past year of production.

We will provide Picatinny with additional ammunition which meets **all** our production standards as soon as our lead supplier gets this problem resolved (probably about 3 weeks) so that accuracy testing can be repeated. It is important to reiterate that Polyshok terminal ballistic performance was **not** effected by this problem as evidenced by the fact the tests which Picatinny conducted that mimicked those seen in our demonstration video, provided exactly the same results.

We regret this problem. We have been in production of the Polyshok ammunition for over a year with a very consistent quality product. All of our Law Enforcement customers have been very impressed with it's performance. Murphy's Law just seemed to intervene at a very unfortunate time.

Jim Middleton
Vice President, Polyshok, Inc.